भारतीय मानक

Indian Standard

IS 16945 : 2018

कांच की दीवारों के लिए अग्नि प्रतिरोधक परीक्षण

Fire Resistance Test for Glass Walls

ICS 13.220.50; 91.060.10

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Glass, Glassware and Laboratoryware Sectional Committee, CHD 10

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Glass, Glassware and Laboratoryware Sectional Committee had been approved by the Chemical Division Council.

Fire-resistive glass provides defence against the spread of flames and smokes and, protect by blocking the transfer of radiant and conductive heat. This glass includes traditional wired glass, glass ceramics and specially tempered glass. They are typically suitable where building codes require an assembly designated “fire resistant” to enclose a space. Examples include wall applications such as stairwells, exit access corridors, or other fire barriers dividing interior construction.

Considering the widespread use of this glass in building, the committee felt necessary to formulate this standard to assess the performance with regards to fire resistance of the glass for use in buildings. The test prescribed in this standard is intended to measure the ability of a representative specimen of load bearing and non-load bearing glass walls to resist the spread of fire from one side to another. It is also applicable to other non-load bearing internal and external non-load bearing walls with glazing.

In the formulation of this standard, considerable assistance has been derived from the following publications:

EN 1363-1 : 2012	Fire resistance tests — Part 1: General requirements
EN 1363-2 : 1999	Fire resistance tests — Part 2: Alternative and additional procedures
EN 1364-3 : 2014	Fire resistance tests for non-load bearing walls — Part 3: Curtain walls
ISO 834-12 : 2012	Fire resistance tests — Elements of building construction — Part 12: Specific requirements for separating elements evaluated on less than full scale furnaces

The composition of the technical committee responsible for formulation of this standard is given in Annex A.

In reporting the result of a test made in accordance with this standard, if the final value, calculated or observed, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’.

Indian Standard

FIRE RESISTANCE TEST FOR GLASS WALLS

1 SCOPE

This standard prescribes a method of test for determining the fire resistance criteria for both load bearing and non-load bearing glass walls. It is applicable to other non-load bearing internal and external walls (almost wholly glazed).

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of and necessary adjuncts to this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS 1382 : 1981	Glossary of terms relating to glass and glassware (*first revision*)
IS 7358 : 1984	Specification for thermocouples (*first revision*)
IS 17004 : 2018	Testing methods for processed glass

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1382 and the following shall apply.

3.1 Actual Material Properties

Properties of a material determined from representative samples taken from the test specimen for the fire test according to the requirements of the specific product standard.

3.2 Aspect Ratio

The ratio of height of a pane to its width.

3.3 Associated Construction

Form of construction other than glass wall as required to support test specimen during fire resistance test, for example, the aerated concrete slabs on top of a beam.

3.4 Characteristic Material Properties

Materials used for design purposes have an identified set of properties called characteristic material properties.

3.5 Deflection

Movement associated with structural and/or thermal actions.

3.6 Discrete Area(s)

A portion(s) of the total surface of the construction, excluding framing/joints etc., which may be expected to have different fire insulation performance.

3.7 Element of Building Construction

A defined construction component, for example, a wall, partition, floor, roof, beam or column.

3.8 Exposed Face

The side of the test construction that is exposed to the heating conditions of test.

3.9 External Exposure

Exposure to fire originating from external elements like buildings in vicinity, vehicles etc.

3.10 External Non-load Bearing Wall

A wall forming the external envelope of a building which may be exposed to an internal or external fire.

3.11 Extreme Fibre Stress

Stress developed in the extreme fibres of a material when subjected to bending.

3.12 Fire Resistant Glazing

A glazing system consisting of one or more transparent or translucent panes with a suitable method of mounting, with, for example, frames, seals, fixing materials etc. capable of satisfying the appropriate fire resistance criteria.

3.13 Glazed Elements

Building elements with one or more (light transmissive) glass panes, which are installed in a frame with fixings and seals.

3.14 Glowing

The emittance of light without flaming associated with combustion of a material.

3.15 Heat Flux

The quantity of heat energy per unit area incident on the target of the measuring device. It includes heat transferred by convection as well as radiation.

3.16 Insulated Glazing

Fire resistance glazing which satisfies both the integrity and insulation criteria for the anticipated fire resistance duration.

3.17 Insulated Non-load Bearing Wall

A wall, with or without glazing, which satisfies both integrity and insulation criteria for the anticipated fire resistance duration.

3.18 Insulation

The ability of a test specimen of a separating element of building construction to restrict temperature rise of the unexposed face to below prescribed levels when exposed to fire on one side.

3.19 Integrity

The ability of a test specimen of a separating element of building construction to prevent the passage of flames and hot gases through it and to prevent the occurrence of flames on the unexposed side, when exposed to fire on one side.

3.20 Internal Non-load Bearing Wall

A wall, (with or without glazing), which provides fire separation. It may be exposed to a fire from either side.

3.21 Internal Exposure

Exposure to fire originating from within an area of occupancy, such as a room or floor of a building.

3.22 Internal Thermocouple

Thermocouple used to measure the temperatures of the individual components or parts of a specimen within its construction.

3.23 Internal Temperature

Temperature of the individual components or parts of a specimen within its construction.

3.24 Load Bearing Capacity

The ability of a test specimen of a load bearing element to support its test load, without exceeding prescribed criteria with respect to both the extent and rate of deflection.

3.25 Load Bearing Element

An element that is intended for use in supporting an external load in a building and maintaining this support in the event of a fire.

3.26 Load Bearing Wall

A wall which may be subjected to external loads other than its self weight.

3.27 Mullion

A vertical framing member supporting and separating two adjacent panes of glass or panels.

3.28 Neutral Pressure Plane

The elevation at which pressure inside the furnace is equal to the outside.

3.29 Non-load Bearing Wall

A wall designed not to be subject to any load other than its self-weight.

3.30 Notional Floor Level

The assumed floor level relative to the position of the building elements in service.

3.31 Pane

A single piece of glass.

3.32 Plinth

A form of standard supporting construction that reduces the height of the opening of the furnace by raising the support base used to accommodate the test specimen.

3.33 Restraint

The constraint (induced by thermal and/or mechanical actions) provided by the condition at the ends, edges or supports of a test specimen to expansion and rotation. Examples of different types of restraint are:

a) longitudinal,
b) rotational, and
c) lateral.

3.34 Separating Element

An element of building construction to reduce the passage of hot and/or cold gases or smoke from one side of the element to the other without causing failure of the performance criteria.

3.35 Smoke Leakage

The ability of an element of construction to effectively reduce the passage of hot and/or cold gases or smoke from one side of the element to the other.

3.36 Sponsor

The party which intends to do a fire test for its product in an authorized testing laboratory.

3.37 Standard Supporting Construction

Form of construction used to close off the furnace and to support the glass wall being evaluated and which has a quantifiable influence on both the thermal heat transfer between the construction and the test specimen and provides known resistance to thermal distortion.

3.38 Supporting Construction

The construction that may be required for the testing of some building elements into which the test specimen is assembled, for example, the wall into which a door is fitted.

3.39 Sustained Flaming

Continuous flaming for a period of time greater than 10 s.

3.40 Test Construction

The complete assembly of the test specimen together with its supporting construction.

3.41 Test Frame

The frame for the purpose of mounting the test construction on the furnace.

3.42 Test Load

The load applied to the test specimen.

3.43 Test Specimen

Glass wall which is to be installed in a standard or associated supporting construction to allow it to be evaluated.

3.44 Transom

A horizontal framing member separating and supporting two adjacent panes of glass or panels.

3.45 Uninsulated Non-load Bearing Wall

A wall which satisfies the integrity and where required the radiation criteria for the anticipated fire resistance period, but which is not intended to provide insulation. Such a non-loadbearing wall may consist entirely of uninsulated fire resistant glazing.

3.46 Uninsulated Glazing

Fire resistant glazing which satisfies integrity and where required, radiation criteria for the anticipated fire resistance period but which is not intended to provide insulation.

4 APPARATUS

4.1 Furnace

4.1.1 The furnace shall be designed to employ liquid or gaseous fuels and shall be capable of:

a) Heating of vertical or horizontal separating elements on one face;
b) Heating of columns on all sides;
c) Heating of walls on more than one side, where appropriate; and
d) Heating of beams on three sides, as appropriate.

4.1.2 The furnace linings shall consist of materials with densities less than 1 000 kg/m^3. Such lining materials shall have a minimum thickness of 50 mm and shall constitute at least 70 percent of the internally exposed surface of the furnace. The furnace shall be capable of providing standard fire exposure conditions with respect to thermal exposure and pressure.

NOTE — Furnaces may be designed so that assemblies of more than one element can be tested simultaneously, provided all the requirements for each individual element can be complied with.

4.2 Loading Equipment

The loading equipment shall be capable of applying the load as determined in accordance with **10.2** on the test specimen. The load may be applied hydraulically, mechanically or by the use of weights.

4.2.1 The loading equipment shall be able to simulate conditions for the application uniform loading, point loading, concentric loading, axial loading or eccentric loading as appropriate for the test construction. The loading equipment shall be capable of maintaining the test load at a constant rate (± 5 percent of the required value), without changing its distribution and resulting in deflection of the test specimen at prescribed rate till maximum deflection or failure of load bearing capacity occurs as defined in **11.1** or for the duration of the test, whichever occurs sooner.

4.2.2 The loading equipment shall not significantly influence the heat transfer through the test specimen nor impede the use of the thermocouple insulating pads. It shall not interfere with the measurement of surface temperature and/or deflection and shall permit general observation of the unexposed face.

4.2.3 The total area of the contact points between the loading equipment and the test specimen surface shall not exceed 10 percent of the total area of the surface of a horizontal test specimen.

4.3 Test Frames

Special test frames or other means shall be employed to reproduce the boundary and support conditions appropriate for the test constructions as required by **7.2**. Different types of test constructions require test frames of different stiffness. The performance of the test frames shall be evaluated by applying an expansion force within the frame at mid-width between two opposite members and measuring the increase in the internal dimension. The increase shall not exceed 5 mm with an applied force of 25 kN. This evaluation shall be conducted in both the directions of the frame.

4.4 Measuring and Control Equipments

These are required to monitor the test construction, the laboratory and the furnace environment and the behavior of the test sample during the test.

4.4.1 *Instrumentations*

4.4.1.1 *Furnace thermocouples*

The furnace thermocouples shall be plate thermometers which comprise an assembly of a folded steel plate, the thermocouple fixed to it and containing insulation material. The plate shall be constructed from

(150 ± 1) mm long × (100 ± 1) mm wide × (0.7 ± 0.1) mm thick nickel alloy sheet strips. The measuring junction shall consist of nickel chromium/nickel aluminium (type K) wire, contained within mineral insulation in a heat resisting steel alloy sheath of nominal diameter 1 mm, the hot junctions being electrically insulated from the sheath. The thermocouple hot junction shall be fixed to the geometric centre of the plate by a small steel strip. The steel strip can be welded to the plate or may be screwed to it to facilitate replacement of the thermocouple. The strip shall be approximately 18 mm × 6 mm if it is spot welded to the plate and, nominally 25 mm × 6 mm if it is to be screwed to the plate. The screw shall be 2 mm in diameter. The assembly of plate and thermocouple shall be fitted with a pad of inorganic insulation material nominally (97 ± 1) mm × (97 ± 1) mm × (10 ± 1) mm, density 280 ± 30 kg/m^3. Before the plate thermometers are first used, the complete plate thermometer shall be aged by immersing in a pre-heated oven at 1 000ºC for 1 h.

4.4.1.2 *Fixed specimen thermocouples*

It is consisting of either type T or type K thermocouple wires (*see* IS 7358) with a maximum diameter of 0.5 mm, brazed to a 12 mm diameter, 0.2 mm thick copper disc. Each thermocouple shall be provided with a 30 mm square, 2 ± 0.5 mm thick pad of insulation material. This insulation material shall have dry density of 900 ± 90 kg/m^3, a thermal conductivity of 0.13 W/m-K ± 10 percent at 100°C, and shall be of a material capable of withstanding temperatures of 400°C without any change in mechanical or physical properties. The insulation pads shall be slotted or provided with holes to accommodate the thermocouple wires.

The wires from the thermocouples shall be connected either directly or via compensating leads to an appropriate temperature indicator.

4.4.1.3 *Roving surface thermocouples*

It is a measurement junction consisting of either type T or type K (*see* IS 7358) thermocouple wires with a diameter of 1.0 mm, brazed to a 12 mm diameter, 0.5 mm thick copper disc. The wires shall be bent normal to the rear face of the copper disc to allow them to be inserted into separate holes in a porcelain insulator. The porcelain insulator shall have a diameter of 6 mm to 10 mm and shall contain two holes of approximate 2 mm diameter. The distance between the rear face of the copper disc and the end of the insulator shall be 6 ± 1 mm.

The wires of the thermocouple shall be connected either directly or via compensating leads to appropriate temperature indicator.

NOTE — During the test, it is possible that the surface temperature of certain areas may surpass the permissible maximum temperature limit. This can be observed in the form of colour change in those areas due to hot spots. In such a situation, to assess the temperature of these spots the roving thermocouple is required.

4.4.1.4 *Specimen internal thermocouples*

Required for measuring internal temperatures.

4.4.1.5 *Deformation measuring devices*

It is used for measuring deformation of the test specimen having a range sufficient to take account of any deformation due to the initial application of test load, any creep experienced under the test load prior to the heating period, and any deformation that occurs during the heating period. The measurement shall be made to an accuracy of ± 1 mm.

The location for fixing of deformation measurement devices shall be such that no part of such devices shall have any interference with the mechanical or thermal behavior of the test specimen and they shall not be subjected to temperature effects which would result in loss of accuracy.

The deformation measuring devices shall be capable of indicating and recording the same remotely. The deformation indicated by the devices shall be displayed continuously or updated at intervals not exceeding 15 s. The deformation shall be logged at 1 min intervals from the commencement of the heating period, for the calculation of the rate of deformation of the specimen.

4.4.1.6 *Radiometer*

It shall be capable of measuring irradiance in the range of 0 to at least 50 kW/m^2. The time constant shall not be more than 3 s. The instrument shall normally be calibrated with vertical target and the sensitivity shall not change by more than 1 percent when the instrument is used with the horizontal target. The target receiving radiation shall be circular, flat, not more than 100 mm diameter, and coated with durable matt black finish. The target shall be within a water or air cooled body whose front face shall be flat and coincide with the plane of the receiving face of the target. Radiation shall not pass through any window before reaching the target. The instrument shall be robust, easy to install and use, insensitive to draughts and stable. The instrument shall have an accuracy of within ± 3 percent and repeatability within ± 5 percent.

The output from the radiometer shall be measured in appropriate millivolt.

4.4.2 *Cotton Pad*

It is used for monitoring the permeability and consists of new, undyed and soft cotton fibres, without any admixtures of man-made fibres. It shall be 100 mm square and 20 mm thick and shall have a mass of 3 to 4 g. It shall be dried in an oven at 105 ± 5°C for at least 30 min and then stored in a desiccator to cool before use. It shall be placed, immediately prior to use, in a wire holder.

4.4.3 *Gap Gauges*

It is used for monitoring of impermeability. They shall be made of steel rod of diameters 6 ± 0.5 mm and 25 ± 0.5 mm. They shall be provided with handles that are of sufficient length to ensure operator safety and at the same time ensure the accuracy and care which is needed in determination of point of failure.

Minimum length of the gap gauge shall be $t + 25$ mm, where t is the thickness of the specimen.

4.4.4 *Devices for Recording*

a) Furnace temperature,

b) Furnace pressure, and

c) Specimen interior temperature.

4.4.5 *Other Ancillary Devices*

a) Fixed and roving furnace temperature devices,

b) Radiation measuring devices, and

c) Timing devices.

5 TEST CONDITIONS

5.1 Heating Conditions

The fire exposure curves for external non-load bearing wall shall be plotted from the formulae given in **5.1.1.**

It is not applicable to:

a) Curtain walls (external non-load bearing walls suspended in front of the floor slab); and

b) Non-load bearing walls, containing door assemblies.

5.1.1 *Temperature/Time Conditions*

a) For internal exposure — The temperature/time conditions shall be as expressed by the following equation:

$$T = 345 \log_{10}(8t + 1) + 20$$

Where,

T = Mean furnace temperature, in degree C; and

t = Time up to a maximum of 360 min.

Table 1 Temperature Values as per Standard Temperature-time Curve

Sl. No. (1)	Time *t* (min) (2)	Furnace Temperature *T* (°C) (3)	Time *t* (min) (4)	Furnace Temperature *T* (°C) (5)
i)	0	20	90	1 006
ii)	5	576	120	1 049
iii)	10	678	150	1 082
iv)	15	738	180	1 110
v)	20	781	210	1 133
vi)	30	842	240	1 153
vii)	45	902	300	1 186
viii)	60	945	360	1 214

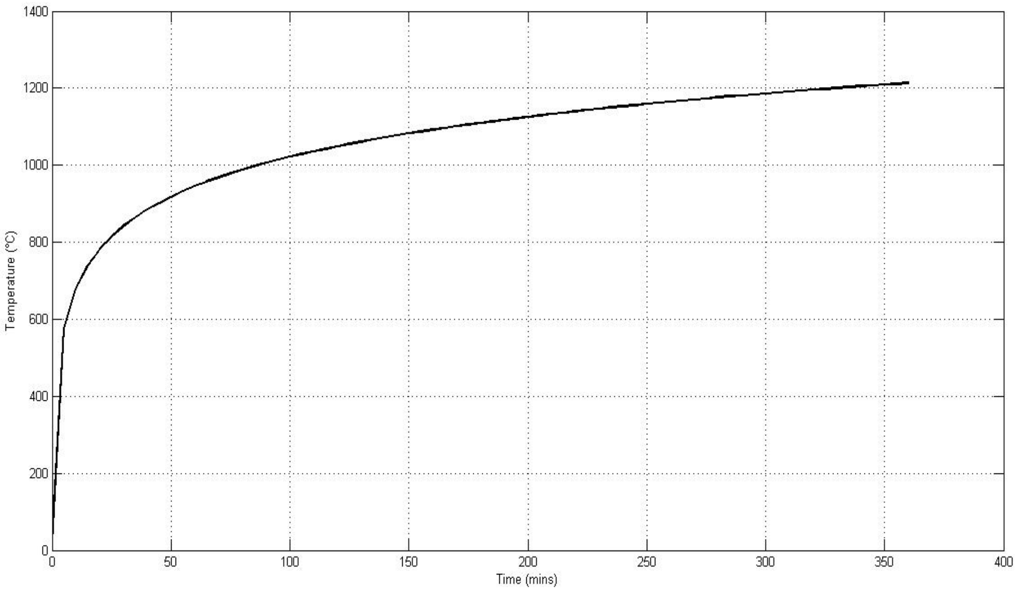

FIG. 1 STANDARD TEMPERATURE — TIME CURVE

b) For external exposure — The temperature/time conditions shall be expressed by the following equation:

$$T = 660\ (1 - 0.687e^{-0.32t} - 0.313e^{-3.8t}) + 20$$

where,

T = Mean furnace temperature, in degree C; and

t = Time up to a maximum of 360 min.

5.1.2 *Tolerances*

5.1.2.1 The percentage deviation (p) in the area of the mean furnace temperature/time curve from the standard temperature/time curve plotted as per **5.1.1** is given by

$$p = \frac{A - B}{B} \times 100$$

Where,

A = Area under the mean furnace temperature/time curve observed during test; and

B = Area under the specified temperature/time curve.

5.1.2.2 For the purpose of computing the percentage deviation (p), the areas under the respective temperature/time curves shall be computed at a maximum of the following time intervals:

a) 0 min to 10 min, at 1 min intervals;
b) 10 min to 30 min, at 2 min intervals;
c) 30 min to 120 min, at 5 min intervals; and
d) 120 min to 360 min, at 10 min intervals. Any deviation shall be within the following limits:
    1) Less than 15 percent to the end of the first 10 min of the heating period or to the end of the test if duration of the test is less than 10 min.
    2) Less than 10 percent from 10 min to the end of the first 30 min of the heating period or to the end of the heating period if the duration of the test is greater than 10 min but less than 30 min.
    3) Less than 5 percent from 30 min to the end of the heating period.

5.1.3 *Uniformity of Temperature Distribution*

5.1.3.1 At any time after the first 10 min of the heating period, the temperature rise indicated by any of the thermocouples shall not differ from the corresponding temperature rise given by the standard temperature/time curve by more than 100°C.

5.1.3.2 For test construction where either test specimen or any associated construction incorporating combustible materials that produce flaming within the furnace and cause localized heating or cooling of one or more of the furnace thermocouple hot junctions, the temperature rise recorded by those thermocouples so affected shall not exceed corresponding temperature rise given by the standard temperature/time curve by more than 200°C.

5.2 Pressure Conditions

After the first 5 min of the heating period and for the remainder of the test duration, a positive pressure relative to the laboratory shall be established within the furnace. This pressure shall be controlled to satisfy the requirements for respective elements as prescribed below.

5.2.1 *Separating Elements*

The test construction shall be subjected to a pressure condition such that a linear pressure gradient of 8.5 Pa per 1 000 mm height exists. This pressure is measured relative to a neutral pressure axis at a height of approximately 1 000 mm above the notional floor level. The pressure at any position on the vertical test construction and on the underside of a horizontal test construction shall be determined with respect to the positional height of the element relative to the notional floor level. The pressure condition shall be controlled to within ± 2 Pa. Notwithstanding the above, the pressure at the top of a vertical test construction and at the underside of a horizontal test construction shall not exceed a maximum value of 20 Pa at any time.

5.2.2 *Non-Separating Elements*

Non-separating test elements shall be subjected to similar pressure conditions as appropriate to separating elements with the same orientation, that is, beams as per floors, columns as per walls.

5.3 Ambient Conditions Within the Laboratory

5.3.1 The ambient air temperature, as measured by thermometer in the general vicinity of the test construction shall be within 5°C to 35°C immediately prior to the heating period.

5.3.2 For measurements of the unexposed face temperature rise in separating elements, the following additional requirements shall apply:

a) Thirty min prior to the commencement of the test, the mean unexposed face temperature as indicated by the thermocouples shall be within 5°C of the ambient temperature and shall not be less than an actual temperature of 5°C.
b) During the course of heating period the ambient temperature shall not increase above its initial value by more than 5°C up to the time of insulation failure.
c) Measurements shall be made in essentially draught free conditions.

5.3.3 For tests on separating elements where the unexposed face temperature is only determined for other reasons, for example, for determining the time at which to discontinue the use of the cotton pad, the conditions listed in a) and c) of **5.3.2** shall be complied with but the temperature rise in b) is permitted to increase by 15°C.

5.4 Loss of Accuracy

Where the mean furnace temperature, pressure conditions and ambient conditions in the laboratory go beyond the levels as prescribed above, the actual test results achieved may still be accepted as valid.

6 TEST SPECIMEN

6.1 Size

If the dimension (height or width) of the construction is 3 m or smaller, then the test specimen shall be tested to full size. If the dimension of the construction is higher than 3 m, then the test specimen shall be tested for dimension of at least 3 m.

6.2 Number

6.2.1 For separating elements that are only required to be fire resistant from one side, that face that will be subject to fire shall be oriented as the fire side. For separating elements that are required to be fire resistant from both the sides, two specimens shall be tested separately (one from each side) unless the separating element is fully symmetrical and the required fire exposure conditions for both the directions are identical or it can be established that a particular face of the test specimen presents a more onerous condition for passing the test.

6.2.2 If testing is carried out from only one side, whether due to the fact that the separating element is symmetrical or because it is only required to resist fire from one side, this shall be stated in the test report.

6.3 Design

6.3.1 The test specimen shall be either:

a) Fully representative of the construction intended for use in practice, including any surface finishes and fittings which are essential part thereof and may influence its behavior in the test; or
b) Be designed to obtain the widest applicability of the test result to other similar constructions.

The design feature which influence fire performance that shall be included to give the widest application can be derived from the field of direct application (*see* **13**).

6.3.2 If the objective of a fire test is to obtain information on a specific system for particular end use, then the applicable specific construction shall be used for the test specimen. However, if the intention is to obtain data for a wider application similar to other constructions, then a single test may justify the inclusion of certain design features in the test specimen.

6.3.3 The test specimen shall not contain mixtures of different types of construction, for example, brick or blocks in a wall unless this is full representative of the construction in practice. Where the test specimen can incorporate at least two full width panels, the free edge shall be adjacent to a full size panel on the exposed face. When it is not possible to incorporate two full size panels into the test specimen, the single full size panel shall be located in the centre of the specimen, with smaller panels of equal width on each side. The smaller panels shall not be less than 500 mm wide. Where the smaller panels would be less than 500 mm wide, only one shall be used next to the free edge of the specimen.

6.3.4 The fire resistance of a glazed system is a function of the nature of the glass, the size and aspect ratio of the panes, the characteristics of the framing members, the method of retention and provisions for expansion. Guidance on the design of glazed specimens is given hereunder:

6.3.4.1 A non-load bearing wall may contain a discrete glazed panel, a substantial number of such panels or it may consist almost entirely of glazed units. These may be small framed units or large panes with substantial frames attached to masonry or similar surrounds. Under fire conditions the separating element is expected to provide satisfactory fire barrier and this requirement applies to glazed and unglazed parts of the system.

6.3.5 The following features can only be incorporated in similar constructions provided they were included in the test specimen.

a) Non glazed panels;
b) Junction(s) between a transom and a mullion ('+ joints');
c) Junction(s) of mullions terminating at a transom ('T' joints);
d) Junction(s) between transom(s) and mullion(s) where mullion(s) is/are full height and interrupt(s) transoms;
e) Special jointing systems between glazed elements or between glazed elements and other constructions; and
f) Other constructional features to be evaluated, for example, structures present for safety or security reasons such as crowd barriers, grills, etc.

For framed systems, the largest glass pane shall be located next to the mullion on the free edge.

For butt-jointed systems, the design of the test specimen shall include at least 2 vertical joints.

6.4 Construction

The method of construction and erection shall be representative of the use of the element in practice and the standard of workmanship shall be as normally provided in buildings. This shall include the same way of accessing the test specimen, for example, suspended ceilings (normally from below).

a) The sponsor shall ensure that the quality of construction of the test specimen is representative of the product in practice.

b) The laboratory shall monitor the erection of the test specimen in order to include details of methodology and workmanship in the test report.

6.5 Verification

6.5.1 The sponsor shall provide a detailed specification and description (for example, constructional details, drawings, schedule and dimensions of major components, procedure for mounting, fixing and assembling including those for items of building hardware) to a level and sufficiently in advance of performing the test. This should enable the laboratory to conduct a detailed examination of the test specimen to verify its conformity with the information provided. As far as possible, any area of discrepancy shall be resolved prior to the starting of the test.

6.5.2 In some instances, the method of construction prevents a detailed survey of the test specimen without having to permanently damage it or it is considered that it will subsequently be impossible to evaluate construction details from a post test examination. In such cases the laboratory shall judiciously exercise one of the following two options as given below, to decide which of test specimen shall be submitted to the test and which one shall be used to verify the construction:

a) the laboratory shall oversee the fabrication of the test specimen; or

b) request sponsor to supply an additional test specimen or part of the test specimen which cannot be verified (for example, for testing of door or a door leaf etc.)

6.5.3 However, where appropriate, the actual material properties shall be determined.

6.5.4 In some instances, it may not be possible to verify the conformity of all aspects of the construction of the test specimen prior to the test and adequate evidence may not be available after test. When it is necessary to rely on information provided by the sponsor, then this shall be clearly stated in the test report. The laboratory shall nevertheless ensure that it fully appreciates the design of the test specimen and be able to accurately record the constructional details in the test report. Record additional procedures if applied for specimen verification in the test methods for specific products.

6.5.5 The process of verification may be carried out by a third party. However the responsibility shall remain with the laboratory.

7 INSTALLATION OF TEST SPECIMEN

The test specimen shall be installed, as far as possible, in a manner representative of its use in practice and as prescribed by sponsor. The test specimen shall be mounted as near as possible to the exposed vertical plane of the test frame or supporting construction as appropriate, unless a different position is used in practice. The whole area of the test construction shall be exposed to the heating conditions.

7.1 Standard Supporting Construction

7.1.1 The choice of standard supporting construction shall reflect the intended normal use of the test specimen. If the size of the test specimen is smaller than the opening in the test frame then it shall be installed in the test frame using one of the following procedures:

a) Where the height of the test specimen is smaller than the height of the test frame opening, then a plinth shall be provided to reduce the opening to the required height. The plinth shall possess sufficient stability for the test specimen and shall be selected from one rigid standard supporting construction.

b) Where the width of the test specimen is smaller, a standard supporting construction shall be provided on the vertical sides of the opening selected from either the rigid or flexible standard supporting constructions as prescribed below:

   1) High density rigid construction — This kind of construction consists of either of blockwork, masonry or homogenous concrete wall with an overall density ≥ 850 kg/m^3 and has a thickness appropriate for the expected fire resistance period.

   2) Low density rigid construction — This kind of construction consists of an aerated concrete block wall with an overall density of 650 ± 200 kg/m^3 and has a thickness appropriate for the expected fire resistance period.

   3) Mortar — For blockwork (incorporating aerated concrete) or masonry wall supporting constructions given above, the individual masonry units shall be bonded together with a mortar appropriate for the expected fire resistance period.

   4) Flexible construction — The lightweight plasterboard faced steel stud partition should constructed according to its relevant details for the intended fire resistance period as required by the sponsor.

7.2 Non-standard Supporting Construction

If the test specimen is mounted in a supporting construction not given in **7.1**, then the result will only be valid for non-load bearing walls mounted in the construction as tested.

8 CONDITIONING

8.1 Test Specimen

8.1.1 Before initiation of the test, the strength and moisture content of the test specimen shall be approximate to those expected in normal service. The test specimen shall preferably not be tested unless it has reached an equilibrium resulting from storage in an ambient atmosphere of 50 percent relative humidity at 27 ± 2°C. If the test specimen is conditioned in a different way, it shall be clearly stated in the test report.

8.1.2 Concrete and masonry elements or specimens containing concrete parts shall not be tested until they have been conditioned for 28 days.

8.1.3 Massive constructions, for example, large concrete elements, which may contain large amounts of moisture, may take a very long time to dry out. Such specimens may be tested when relative humidity at relevant positions of the test specimen has reached 75 percent. If the level of 75 percent relative humidity cannot be reached within a reasonable time, moisture content at the time of testing shall be measured and reported.

8.2 Supporting Constructions

When a test specimen is mounted with a supporting construction for example, a non-loadbearing wall mounted in a concrete or masonry wall supporting construction, full conditioning of the support construction may not be necessary. However, it needs to be demonstrated that there will be no influences on the behavior of the specimen caused by excessive moisture for example, lack of strength, spalling, moisture induced deformation, temperature influences etc.

9 APPLICATION OF INSTRUMENTATIONS

9.1 For temperature

9.1.1 *Furnace Thermocouples*

Position the furnace thermocouples, one for each 1.5 m^2 or part thereof of the exposed surface area (nominal area measured in the plane of the specimen). For specimen with exposed surface area less than 6 m^2, at least four furnace thermocouples shall be used. Distribute the thermocouples uniformly ensuring that none of the thermocouples are closer than 500 mm from the furnace walls. The thermocouple hot junctions shall be at 100 ± 10 mm from the surface of the test specimen at the start of the heating period. If the exposed surface is irregular, thermocouple shall be placed 100 ± 10 mm away from the median depth of the wall, provided the junction is not closer than 50 mm from any part of the exposed surface. For partitions that incorporate glazing, place one thermocouple directly in front of the glazing for every 20 percent of the specimen area covered by glazing.

NOTE — When the area of glass is less than 20 percent of the specimen area, no thermocouples need to be placed in front of the glazed area as prescribed above.

9.1.2 *Unexposed Face Thermocouples*

9.1.2.1 *General*

No unexposed surface thermocouples are required where no evaluation of the test specimen against the insulation criteria is required. Surface thermocouples of the type described in **4.4.1.1** shall be attached to the unexposed face to measure the average and the maximum temperature rise where evaluation against the insulation criteria is required. Thermocouples should be preferably attached to the surface of the specimen by the use of heat resisting adhesive covered by an insulation pad. There should be no adhesive between the copper disc of the thermocouple and the specimen or between the copper disc and the pad.

All thermocouples used for determination of average unexposed face temperature shall not be placed within 50 mm of features like thermal bridges, joints, junctions, through connections and fixings such as bolts, and screws etc.

All thermocouples for determination of maximum unexposed face temperature shall not be placed closer than 20 mm to any discontinuity in the element.

9.1.2.2 *Average temperature rise*

For the purpose of measuring the average temperature rise, one thermocouple shall be provided at every 1.5 m^2 area of the specimen. A minimum of two thermocouples shall be provided for each pane at the centre of two quarters along the diagonal line.

9.1.2.3 *Maximum temperature rise*

Additional thermocouples shall also be placed to the framing members and panes to ensure compliance of the maximum temperature rise criterion as follows:

a) On the top horizontal framing member at mid width of the specimen;
b) On the top horizontal framing member in line with a mullion;
c) At the junction of a mullion and transom;
d) On the vertical framing member on fixed edge at mid height of the specimen;
e) At mid-height of the free edge, 150 mm away from the edge;

f) At mid-width of a transom (in the positive pressure zone);
g) At mid-height of a mullion (in the positive pressure zone);
h) At mid-height of the pane with largest area, 20 mm away from the vertical framing member or the joint. If the largest pane is not the tallest pane, then another thermocouple shall be placed at the mid height of the tallest pane, 20 mm away from the vertical framing member or the joint;
j) At mid-width of the pane with largest area, 20 mm away from the horizontal framing member and from the joint at the top edge. If the largest pane is not the widest pane then another thermocouple shall be placed at mid-width of the widest pane, 20 mm away from the horizontal framing member and from the joint at the top edge; and
k) At top corners of the pane with the largest area, and, as well as in the top corners of the highest placed pane with the largest area, if they are not the same panes.

9.2 For Pressure

The pressure sensor inside the furnace shall be placed such that it shall neither be subject to direct impingement of convection currents from the flames nor be in the path of the exhaust gases. It shall be installed in such a manner that the pressure can be measured and monitored during test in order to attain the conditions prescribed in **5.2**. The position of the tubes shall be horizontal both in the furnace and as they exit through the furnace wall, such that the pressure is relative to the same positional height from the inside to the outside of the furnace. Any vertical section of the tube to the measuring instrument shall be maintained at ambient temperature.

9.2.1 *At Furnaces*

One pressure sensor shall be provided to record and control furnace pressure.

9.2.1.1 *For vertical elements*

A second sensor may be used to provide information on the vertical pressure gradient within the furnace. This sensor, if required, shall be located at least 1 m above or below the position of the first sensor.

9.3 For Deflection

Instrumentation for the measurement of deflection of the test specimen shall be located to provide data in terms of the amount and rate of deflection during, and after the fire test.

9.4 For Radiation

Heat flux meters shall comply with **4.4.1.6**. The target of the instrument facing the test specimen shall not be shielded by a window or subjected to a gas purge, that is, it shall be subject to convection as well as radiation.

10 METHODS OF TESTS

10.1 Restraint Application

Depending upon its design, relevant restraint may be provided by constructing the specimen inside a rigid frame. This method shall be used for partitions and for certain types of floors, as appropriate. In such case, any gaps between the edges of the test specimen and the frame shall be filled with non- compressible material.

10.2 Load Application

For load bearing elements, the test load shall be applied at least 15 min before the commencement of the test. The load shall be applied at such a rate that no dynamic effects are incurred. All the resulting deflections shall be measured. If the test specimen consists of materials which incur apparent deflections at applied load level, the applied load shall be maintained until the deflections are stabilized prior to the commencement of fire test. Following their application and during the course of the test, the loads shall be kept constant. When deflection of the specimen takes place, the loading system shall respond quickly to maintain a constant value of load.

10.3 Commencement of Test

10.3.1 At least 5 min prior to the commencement of the test, the initial temperatures recorded by all thermocouples shall be checked to ensure consistency and to evaluate the datum values of the thermocouples. Similar datum values shall be obtained where appropriate (for deflection etc.), and the initial condition of the test specimen shall be noted.

10.3.2 The initial average temperature of the internal thermocouples, if required, and the unexposed surface temperature of the specimen shall be 30 ± 10°C. Unexposed surface temperature of the specimen shall not differ from the initial ambient temperature by more than 5°C. The initial temperature of the furnace thermocouples shall be less than 50°C.

10.3.3 The commencement of the test shall be considered when the programme to follow the heating curve has been initiated (igniting the burners).

10.3.4 The elapsed time shall be measured from the commencement of the test and all manual and automatic systems for measurement and observation shall begin or shall be in operation.

10.4 Measurement and Observations

From commencement of the test the following measurements and observations shall be recorded as required.

10.4.1 *Temperatures*

Temperatures of all the thermocouples (except roving thermocouple) shall be measured and recorded at intervals of maximum 1 min for the duration of the heating period. Also when using the roving thermocouple near a discontinuity, for example, between adjacent panels in a wall, the centre of the disc shall not be placed closer than 20 mm to the discontinuity.

A roving thermocouple shall be used for any suspected hot spot if it develops during the test. If a temperature of 150°C is not achieved within 20 s, the application of roving thermocouple may be discontinued. The restrictions on the use of the roving thermocouple are the same as those for fixed thermocouples. The roving thermocouple shall be used only for evaluation of the test specimen for maximum temperature criterion.

10.4.2 *Furnace Pressure*

The furnace pressure shall be measured and recorded continuously or at intervals of maximum 1 min.

10.4.3 *Deflection*

The relevant deflections of the test specimen shall be measured and recorded throughout the test.

10.4.3.1 *Load bearing test specimens*

In the case of loadbearing test specimens, measurements shall be made prior to and during the application of the test load as well as at 1 min intervals during heating period.

For vertical load bearing elements, axial deflection which represents an increased height of the test specimen shall be expressed 'positive deflection'. Deflection which results in a decrease in the height of the test specimen below its original height shall be expressed 'negative deflection'.

10.4.3.2 *Additional deflection measurements (load bearing and non-load bearing test specimen)*

Wherever required, specific measurements of deflection shall be made at locations and at a frequency so as to represent a history of the movement of the test specimen. The relevant information regarding location and frequency of measurement of particular element under test shall be obtained prior to performing fire test. Through judicious approach, frequency of measurement around the time of integrity failure may be increased to generate information on extended application.

10.4.4 *Integrity*

The integrity of separating elements shall be evaluated throughout the test by cotton wool pads, gap gauges and monitoring the test specimen for evidence of sustained flaming.

10.4.4.1 *Procedure A (by cotton pad)*

10.4.4.1.1 *Method*

A cotton pad (*see* **4.4.2**) shall be mounted on a frame and placed on the surface of the test specimen, for a maximum period of 30 s, or until ignition (defined as glowing or flaming) of the cotton pad occurs. Charring of the cotton pad without flaming or glowing shall be ignored. Small adjustments in position may be made so as to achieve the maximum effect from the hot gases.

For irregular surfaces of the test specimen in the area of the opening, care shall be taken to ensure that there is at least 30 mm clearance between the cotton pad and any part of the test specimen surface during the measurements.

The operator may undertake cotton pad tests to evaluate the integrity of the test specimens. Such screening may involve selective short duration applications of the cotton pad to areas of potential failure and/or the movement of a single pad over and around such areas. Charring of the pad may provide an indication of imminent failure. But a new pad shall be employed for integrity failure conformity.

10.4.4.1.2 *Results*

The time of ignition, and the location at which ignition occurred, shall be recorded.

10.4.4.2 *Procedure B (by gap gauges)*

10.4.4.2.1 *Method*

In this method, gap gauges (*see* **4.4.3**) are used. Size of the opening at joints in the surface of the test specimen shall be evaluated at intervals which will be determined by the apparent rate of the deterioration of test specimen. Two gap gauges shall be employed, in turn, and without undue force to evaluate whether:

a) On insertion, the gap gauge of 6 mm diameter is able to pass through the gap and can be moved a distance of 150 mm along the gap.
b) The gap gauge of 25 mm diameter is able to pass through the gap.

Any small interruption to the insertion of the gauge which would have little or no effect upon the transmission of hot gases through the opening shall not be taken into account, for example, a small fastening across the construction joint that has opened up due to distortion.

10.4.4.2.2 *Results*

The period of test at which gap developed at joints during fire test will permit the insertion of the gap gauge through it shall be recorded. The occurrence and duration of flaming on the unexposed surface, together with the location of the flaming shall be recorded.

10.4.5 *Load and Restraints*

For load bearing elements, the time at which the test specimen is unable to support the test load shall be recorded. Any variation in measured forces and/or moments necessary to maintain an applied restraint condition shall also be recorded.

10.4.6 *Radiation*

The radiation shall be measured in a plane parallel to the unexposed face of the test specimen at a distance of 1 m from it. There is no need to measure radiation from a surface with a temperature below 300°C because the radiation emitted from such a surface is low. Measurement shall be taken at appropriate places and throughout the test at intervals not exceeding 1 min.

10.4.6.1 *Apparatus*

Heat flux meter as prescribed in **9.4.**

NOTE — Heat flux comprises of both convective and radiative heat transfer (*see* **3.14**). However, convective heat transfer is usually negligible compared to radiation. Therefore, heat flux may be reported as radiation.

10.4.6.2 *Positioning*

Each heat flux meter shall be positioned 1 m away from the unexposed face of the test specimen. At the beginning of the test, the target of each heat flux meter shall be placed parallel (± 5°) to the plane of the unexposed surface of the test specimen. There shall be no significant radiating surfaces other than the specimen within the field of view. The flux meter shall not be shielded or masked to restrict the field of view.

10.4.6.3 *Measurements*

10.4.6.3.1 It shall be taken at the following locations:

a) Opposite the geometric centre of the specimen. This is referred to as the average radiation level;
b) Point at which the maximum heat flux can be expected. For specimen symmetrical about its centre and a uniform radiator, this point will coincide with position a).

10.4.6.3.2 In other cases, the measurements shall be taken as follows:

a) Identify all areas (in excess of 1 m^2) where it is anticipated that the temperature will exceed 300°C. Measure the radiation opposite the notional centre of each such area;
b) Two or more identical adjacent parts of the specimen having the same height or width, separated by less than 0.1 m, may be tested jointly together as single radiation surface; and
c) If the area or sub areas of the test specimen where the temperature is expected to remain below 300°C is less than 10 percent of the total areas or sub-area, then that area, or sub area, can be treated as a single radiating surface. This allows for breaks as glazing bars.

Measurements taken at each of the location described above shall be recorded throughout the test at intervals of maximum 1 min.

10.4.6.4 *Reporting of results*

At all specific measurement locations, the actual time at which the measured radiation exceeds the values of 5, 10, 15, 20 and 25 kW/m^2 shall be reported. A clear statement should be made indicating whether the observations recorded are on the basis of average or maximum levels.

10.4.7 *Impact Energy and its Measurement*

The fire resistance of specific classes of walls can be influenced by impacts arising from the failure of other components or objects exposed to fire. Resistance to human impact test, as prescribed in **6.4** of IS 17004 (if required) can be applied to load bearing or non-load bearing fire resisting walls.

10.4.8 *General Behavior*

Observations shall be made of the general behavior of the test specimen during the course of the test. Also record other effects such as smoke emission, cracking, melting, softening, spalling or charring etc. of the materials of the test specimen.

10.5 Termination of the Test

10.5.1 The test may be terminated for one of the following reasons:

a) Safety of personnel or impending damage to equipment;
b) Test specimen met the prescribed criteria; and
c) Request of sponsor.

To obtain additional data for direct and/or extended application, the test may be continued inspite of condition prescribed at b).

10.5.2 When a test has been terminated prior to failure of the test specimen, the reason for termination of test shall be clearly stated. The result shall be given as the time of termination of the test and the specimen shall be classified accordingly.

11 PERFORMANCE CRITERIA

11.1 Load Bearing Capacity

This is the time lapsed in minutes, for which the test specimen continues to maintain its ability to support the test load during the test. Support of the test load is determined by both the amount and the rate of deflection calculated from the measurements taken in **10.4.3.1**. The rate of deflection criteria is not applied till a deflection of L/10 has been exceeded since relatively rapid deflection can occur until stable conditions are reached.

a) For flexural loaded elements

Limiting deflection $D = L^2/400d$ mm; and

Limiting rate of deflection, dD/dt = $L^2/9\ 000\ d$ mm/min.

where,

L = clear span of the test specimen, in mm; and

d = distance from extreme fibre of the cold design compression zone to the extreme fibre of the cold design tension zone of the structural section, in mm.

b) For vertically loaded elements Limiting vertical contraction (negative elongation), C = h/100 mm; and

Limiting rate of vertical contraction (negative elongation), dC/dt = 3h/1 000 mm/min

where,

h = initial height, in mm.

11.2 Integrity

These are the times in completed minutes for which the test specimen continues to maintain its separating function during the test without either:

a) Causing the ignition of a cotton pad applied in accordance with **10.4.4.1**;

b) Permitting the penetration of a gap gauge as specified in **10.4.4.2**; or

c) Resulting in sustained flaming.

If a specimen is tested for insulation (EI), the integrity value is determined by whichever of the three criteria (a, b and c) fails first.

If a specimen is tested for integrity alone (E) (or) integrity and radiation control (EW), but not insulation (EI), the integrity value is determined by whichever of criteria (b, c) fails first.

NOTE — Cotton pad test is used to determine integrity failure only in insulation test.

11.3 Radiation

These are the times in completed minutes for which the total radiation value as measured by the radiometer is less than 15 kW/m^2.

11.4 Insulation

11.4.1 This is the time in completed minutes for which the test specimen continues to maintain its separating function during the test without developing temperatures on the unexposed surface which either:

a) Increase the average temperature above the initial average temperature, by more than 140°C; and

b) Increase at any location (including the roving thermocouple) above the initial temperature, by more than 180°C.

11.4.2 The initial average temperature shall be the average unexposed surface temperature at the commencement of the test.

11.4.3 Some elements of construction have different limits of unexposed face temperature rise from those given above. These limits may apply to all or part of the specimen being evaluated.

11.4.4 Details of the limits of temperature rise and location of areas that are permitted to rise higher are given in specific test method.

11.4.5 Where a specimen incorporates discrete areas of different thermal insulation, these shall be evaluated separately according to the specific test method for both average and maximum temperature rise criteria.

11.5 Consequential Effects of Failing Certain Performance Criteria

11.5.1 *Insulation and Integrity versus Load Bearing Capacity*

The performance criteria “insulation” and “integrity” shall automatically be assumed not to be satisfied when “load bearing capacity” criterion ceases to be satisfied.

11.5.2 *Insulation versus Integrity*

The performance criteria “insulation” shall automatically be assumed not to be satisfied when the “integrity” criterion ceases to be satisfied.

12 TEST REPORTS

12.1 Full Test Report

The test report shall contain the following information:

a) The name and address of the testing laboratory;

b) The name and address of the sponsor;

c) The date of the test;

d) The unique reference number of the test;

e) The name of the manufacturer (if known) of the test specimen and of the products and components used in the construction, together with identification marks and trade names;

f) The construction details of the test specimen, including description and drawings and principal details of the components. The description and the drawings which are included in the test report shall, as far as practicable, be based on the information provided by the sponsor and verified by the survey of the test specimen. When full and detailed drawings are not produced by the laboratory to be included in the report, then the sponsor’s drawing(s) of the test specimen shall be authenticated by the test laboratory and at least one copy of the drawing(s) shall be included in the test report. Reference shall be given in the report that the drawings are those provided by the sponsor;

g) The relevant properties of materials and components that have a bearing on the fire performance of the test specimen. Where it is impracticable to measure some of these properties, this shall be reported;

h) The method of assembly and installation of the test specimen;

j) Details of pre-testing conditions of the specimen;

k) A statement concerning the laboratory's involvement in the selection of the test specimen;

m) For load bearing elements, the load applied to the test specimen, the basis for its calculation as provided by the sponsor and the method of loading;

n) The support and restraint conditions employed and the rationale for their selection;

p) For asymmetrical, separating elements, the direction in which the specimen was tested and the reason for this choice;

q) Information concerning the location of all the thermocouples fixed to the specimen, pressure measurement and deflection measurement devices. Drawings shall be included which clearly illustrate the positions of the various devices and identify them relative to the data provided;

r) The ambient temperature of the laboratory at the commencement of the test;

s) The pressure conditions within the furnace related to the position of the test construction;

t) Temperature/time curves of the furnace heating conditions;

u) The reasons validating the test in the event of the tolerances on the temperature/time curve, pressure conditions or ambient laboratory being inadvertently exceeded;

w) The result slated in terms of the elapsed time, in completed minutes, between the commencement of heating and the time of failure with respect to the relevant criteria including:

   i) The rate of deflection when this is the criterion used to assess load bearing capacity, including the value of d used in calculating the limiting rate of deflection for flexural members;

   ii) The maximum deflection and the time and position at which it occurred, supported by adequate graphical data;

   iii) The mode of failure with respect to all integrity criteria;

   iv) The position(s) at which the maximum temperature rise was measured should this be the cause of insulation failure; and

   v) Any alternative and additional tests, for example, radiation.

y) Tabular and/or graphical of the output from all pressure measurement devices, deflection measurement devices, unexposed face thermocouples and where applicable, internal thermocouples;

   NOTE — The report only needs to include a selection of the measured data sufficient to provide a history of the performance of the test specimen. For example, it is not necessary to tabulate the temperature of every thermocouple fixed to a beam at 1 minute intervals for the whole duration of the 90 min test. However, it is recommended that all the measurements be included at around the time of failure of all the criteria being considered. Before and after this period the interval at which measured data needs to be included in the report may be longer, for example 5 to 10 min.

z) A description of the any significant behavior of the test specimen;

aa) The field of direct application of the results for the specimen being evaluated; and

ab) The following statements:

   i) "This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in IS 16945. Any significant deviation with respect to size, construction details, loads, stresses, and edge or end conditions other than those allowed under the field of application in the relevant test method is not covered by this report.

   ii) Because of the nature of fire resistant testing and the constituent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

12.2 Short Form Test Report

In addition to the full test report, an abbreviated version shall be provided, at the specific request of the sponsor, they shall include all the items listed in **12.1**, however items f), g), h), j), m), n), q), t), w), y), and z) may be shortened.

12.3 Expression of Test Results in the Test Report

12.3.1 An example of the method of expressing the test results is given below for a load bearing separating element, where the integrity and insulation criteria were exceed and the test was discontinued at the request of the sponsor before failure of load bearing capacity of the test specimen:

a) "Loadbearing capacity : 128 min no failure (the test having been discontinued at the request of the sponsor)

b) Integrity — sustained flaming : 128 min no failure (the test having been discontinued at the request of the sponsor)

   1) Gap Gauge : 124 min
   2) Cotton Pad : 120 min
   3) Insulation : 110 min"

12.3.2 A typical example of the method for expressing the results is given below for a non-load bearing element:

a) Integrity sustained flaming : 132 min no failure (the test having been discontinued at the request of the sponsor)
   1) Gap Gauge : 132 min
   2) Cotton Pad : 132 min
   3) Insulation area 1 : 20 min
b) Radiation : 66 min

13 FIELD OF DIRECT APPLICATION OF TEST RESULTS

13.1 General

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made. The resulting construction shall continue to comply with appropriate design code for its stiffness and stability.

a) Decrease in height;
b) Increase in thickness of the wall;
c) Increase in thickness of component materials;
d) Decrease in linear dimensions of boards or panels but not thickness;
e) Decrease in stud spacing;
f) Decrease in distance of fixing centres;
g) Increase in the number of horizontal joints if the test specimen has a joint not more than 500 mm from the top edge;
h) The use of surface fittings and fixtures when the test specimen has the fixture or fitting not more than 500 mm from the top edge; and
j) Horizontal or vertical joints, of the type tested.

13.2 Extension of Width

The width of an identical construction may be increased if the specimen was tested at a minimum of 3 m width with one vertical edge without restraint (free edge).

13.3 Extension of Height

The height of constructions tested at a minimum of 3 m, may be increased to 4 m under the following conditions:

a) If the maximum lateral deflection of the test specimen does not exceed 100 mm; and
b) The expansion allowances are increased pro-rata.

13.4 Supporting Constructions

13.4.1 *Standard Supporting Constructions*

The result of a fire test on a non-load bearing wall tested in one of the standard supporting constructions or the test frame will also apply to any other supporting construction within the same type which has a greater fire resistance.

13.4.2 *Non-Standard Supporting Constructions*

The result of a fire test on a non-load bearing wall tested in a non-standard supporting construction is applicable only to that particular construction.

13.5 Field of Direct Application - Limits of Permitted Size Variations

13.5.1 When the test specimen achieves overrun time A, the dimensions of the glass panes (width and/or height) can be increased upto 1.1 times of its tested dimension. However, the resultant area of the glass pane shall not be more than 1.1 times of the maximum tested area.

13.5.2 When the test specimen achieves overrun time B, the dimensions of the glass panes (width and/or height) can increased upto 1.2 times of its tested dimension. However, the resultant area of the glass pane shall not be more than 1.21 times of the maximum tested area.

13.5.3 For test specimens which are tested for integrity and radiation, the following provisions will apply additionally:

a) the average temperature of the unexposed face (both glazed and non-glazed area) remain below 300°C, or
b) the heat radiation measured from the complete and fully glazed element did not exceed 12.3 kW/m².

Table 2 Field of Direct Application Limits of Permitted Size Variations

(*Clause* 13.5)

Sl. No.	Intended Classification (min)	Overrun Time A (min)	Overrun Time B (min)
(1)	(2)	(3)	(4)
i)	≤ 20	Not applicable	≥ 3
ii)	30, 45 and 60	≥ 3 and < 6	≥ 6
iii)	≥ 90	≥ 5 percent and < 10 percent of the intended classification period	≥ 10 percent of the intended classification period

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Glass, Glassware and Laboratoryware Sectional Committee, CHD 10

Organization	*Representative(s)*
CSIR — Central Glass and Ceramic Research Institute, Kolkata	Dr K. Muraleedharan (***Chairman***)
Asahi India Glass Limited	Shri Praveen Saini Shri Navin Rai (*Alternate*)
Bhabha Atomic Research Centre, Mumbai	Dr (Smt.) Madhumita Goswami Dr Purnananda Nandi (*Alternate*)
Borosil Glass Works Ltd	Shri Shrikant Gangan Shri Satish Chitriv (*Alternate*)
Building Materials and Technology Promotion Council	Shri A. K. Tiwari Dr Amit Rai (*Alternate*)
CSIR — Central Building Research Institute, Roorkee	Dr Navjeev Saxena Shri Ajay Chaurasia (*Alternate*)
CSIR — Central Glass and Ceramic Research Institute, Kolkata	Dr K. Annapurna Shri Sitendu Mandal (*Alternate*)
Centre for the Development of Glass Industry	Shri Sanjeev Chinmalli Shri Devendra Sah (*Alternate*)
Confederation Construction Products and Services (CCPS)	Shri Deepak Gahlowt Shri Shashi Kant (*Alternate*)
Controllerate of Quality Assurance (Materials)	Shri Sunil Kumar Shri H. C. Sharma (*Alternate*)
Department of Industrial Policy and Promotion	Shri T. S. G. Narayannen Shri Nand Lal (*Alternate*)
Director General of Supplies and Disposals	Shri R. S. Pandey
Federation of Safety Glass	Shri Sharanjit Singh Shri Gurmeet Singh (*Alternate*)
Glazing Society of India	Shri G. N. Gohul Deepak Shri Mathivanan M. / Shri Subin Calvin Geo (*Alternate*)
Govt College of Engineering and Ceramic Technology	Dr Rituparna Sen Dr (Ms.) Kaberi Das (*Alternate*)
Hindustan Glass Works Ltd	Shri Varun Gupta Shri K. Arvin (*Alternate*)
Hindustan National Glass Industries Ltd	Shri K. K. Sharma
Indian Institute of Packaging	Dr N. C. Saha Shri Bidhan Das (*Alternate*)
Indian Meteorological Department	Shri S. Krishnaiah Shri P. N. Mohanan (*Alternate*)
IIT, BHU, Varanasi	Dr Devendra Kumar
NCERT, New Delhi	Representative
National Physical Laboratory	Dr Sukhvir singh Dr R. K. Garg (*Alternate*)

Organization	*Representative(s)*
National Test House, Kolkata	Dr S. K. Kulshrestha Shri D. V. S. Prasad (*Alternate*)
Office of the Development Commissioner (MSME)	Shri R. K. Bharti Shri Santosh Kumar (*Alternate*)
SAB India Pvt. Ltd., Benguluru	Representative
Saint-Gobain India Pvt. Ltd.	Shri Unnikrishnan A. R. Shri Murali. N. (*Alternate*)
Schott Glass India Pvt. Ltd	Shri Anand Bakshi Shri Hansraj Goud (*Alternate*)
Shriram Institute for Industrial Research	Shri Sanjay Gupta Shri Shambu Thakur (*Alternate*)
Tensil Glass Works	Shri A. N. S. Kumar Shri A. G. Natarajan (*Alternate*)
The All India Glass Manufacturers Federation	Shri Sourabh Kankar Shri Vinit Kapur / Shri Gopal Ganatra (*Alternate*)
United Breweries Group	Shri S. K. Rastogi
Voluntary Organization in Interest of Consumer Education (VOICE)	Shri B. K. Mukhopadhyay Shri K. C. Chaudhary (*Alternate*)
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Borosil Glass Works Ltd.	Shri Shrikant Gangan
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